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Atmospheric Measurement Techniques Discussions

Interactive comment on "Calibration and evaluation of CCD spectroradiometers for airborne measurements of spectral actinic flux densities" *by* Birger Bohn and Insa Lohse

Anonymous Referee #2

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Summary:

This paper characterizes the CCD-SR instrument that deploys on the HALO aircraft and continues the discussion of actinic flux measurements and calibrations using Metcon CCD-based spectrometers. The determination of spectral and wavelength assignment accuracies and sensitivities are discussed and a new technique for removing stray light was demonstrated to improve UV-B spectral accuracy and account for low limits of detection. Cutoff wavelengths are determined for each measured spectra based on radiative transfer modeled fluxes to reduce noise in photolysis products and examine stray light impacts. Ground-based comparisons with low-stray light instrumentation show strong agreement to near the detection limits. The resulting data are shown

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Discussion paper

to be of sufficiently high accuracy for studies of actinic flux and calculated photolysis frequencies. This work is of value, well written and recommended for publishing after addressing the comments.

General comments:

P3 L3-4: The authors contend that “upward radiation in the UV range can often be neglected” at surface sites. Upwelling jNO2 is often 4-10% to the total photolysis and can be much greater. The upward UV radiation can rarely be neglected (though it can be estimated from the downwelling). This sentence should be dropped or adjusted.

P12, L24-27: The authors may have some luck in that they found linear stray light structure in the UV-B in 4 of the 5 tested spectrometers (with the exception of 45853). The paper’s entire stray light analysis relies on a linear-based subtraction. However, non-linear stray light response is not fully controlled for in the manufacturing and is determined by testing after production. Thus, I think they should state explicitly that determination of the stray light spectral structure is required to assess if a linear regression is appropriate.

P19, L13-15: The lookup tables are appropriate for clear-sky determinations of cutoff wavelengths, but no mention is made of the impacts of clouds and aerosols. Extinction by clouds and aerosols can greatly reduce the in situ measured flux and cutoff wavelength would be higher than expected from the table. In these cases, the variability in cutoff could be larger than 2 nm (as mentioned on P18 L5-6). Ideally the measured spectra could be evaluated for the cutoff, in concert with the model. The measurements are often most interesting in these complex atmospheric conditions and a discussion is needed here.

P19-22: Section 3.1.2: A summary of the actinic flux total uncertainties was expected here. Uncertainties were discussed for the calibrations, but what are the measured uncertainties? What is the impact of the improved UV stray light determination that comprises much of the analysis in this paper and how does it improve over previous

evaluations (Jakel et al., etc) . Also, what is the impact of stray light near detection limits where the uncertainty due to stray light determination is much larger (as a function of SZA, ozone, atmospheric conditions).

P22, L17-18: I recognize the complexity of the optical uncertainties (or biases), but I do think a greater summary of the Lohse and Bohn, 2017 results would be appropriate here. They are critical to evaluation of the data and understanding the total measurement uncertainties. This would not hinder the more detailed and quantitative explanations I expect are in the separate publication.

Technical comments:

P1 L13-14: Stray light is not strictly noise but rather a bias that varies with solar intensity. Reword.

P1 L7: "$1\times10\hat{}10$ cm$-$2s$-$1nm$-$1", Units should be photons cm-2 s-1 nm

P10, L5-6: I believe this should read "the SNR increases with the square root of the integration time and also improves at the shorter lamp distance"

P10, L9: Expand PTB to Physikalisch-Technische Bundesanstalt

P11, Fig 5 caption: Change to ". . .stray light signals were also subtracted"

P12, L29: Remove "also"

P13, L11: Remove "also"

P22, L2: Remove "Evidently, also"

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